

والتجربة

3 Selectivity $\Rightarrow$ the ability of the receiver to reject the unwanted signals.

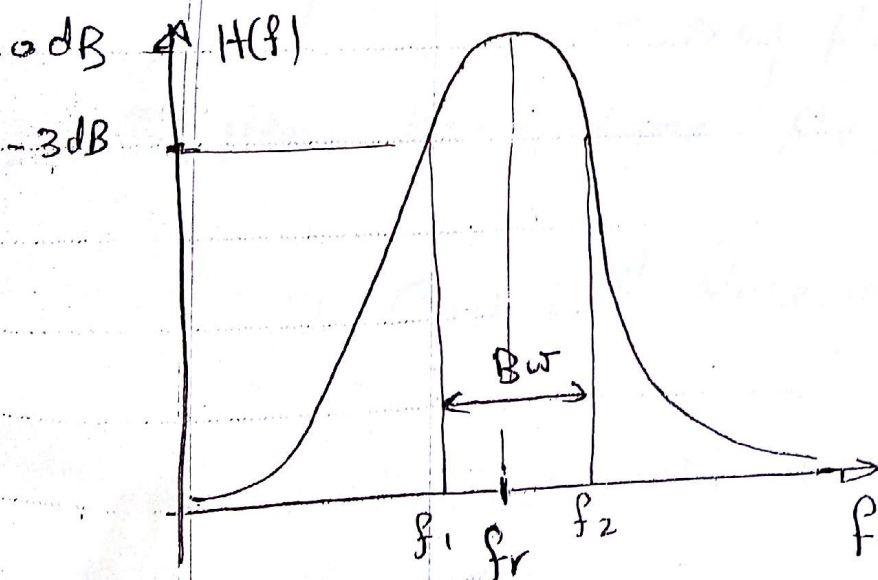
* Selectivity is obtained by using Tuned Circuits and Filters

* As the No of Filters increase the selectivity increases

* As The Quality factor Q increase " " " "

$Q \uparrow \Rightarrow$ Selectivity $\uparrow$

* The Bw of the tuned circuit must be wide enough to pass the signal and its sidebands, and narrow enough to eliminate the unwanted signals.



$$Bw = f_2 - f_1$$

$$Bw = \frac{f_r}{Q}$$

2] Sensitivity

the ability of the Rx to ^{feel}sense and amplify the weak signals.

* the higher the amplifier gain the high the Rx selectivity

* High gain receiver is obtained by using multiple amplification stages

Types of Receivers

- ① Crystal Receiver
- ② tuned Radio Frequency Rx,
- ③ Super heterodyne Rx,

Crystal Receiver

هوا بطن أنواع ال AM Rx و يتكون من

① tuned circuit

which provide the selectivity such

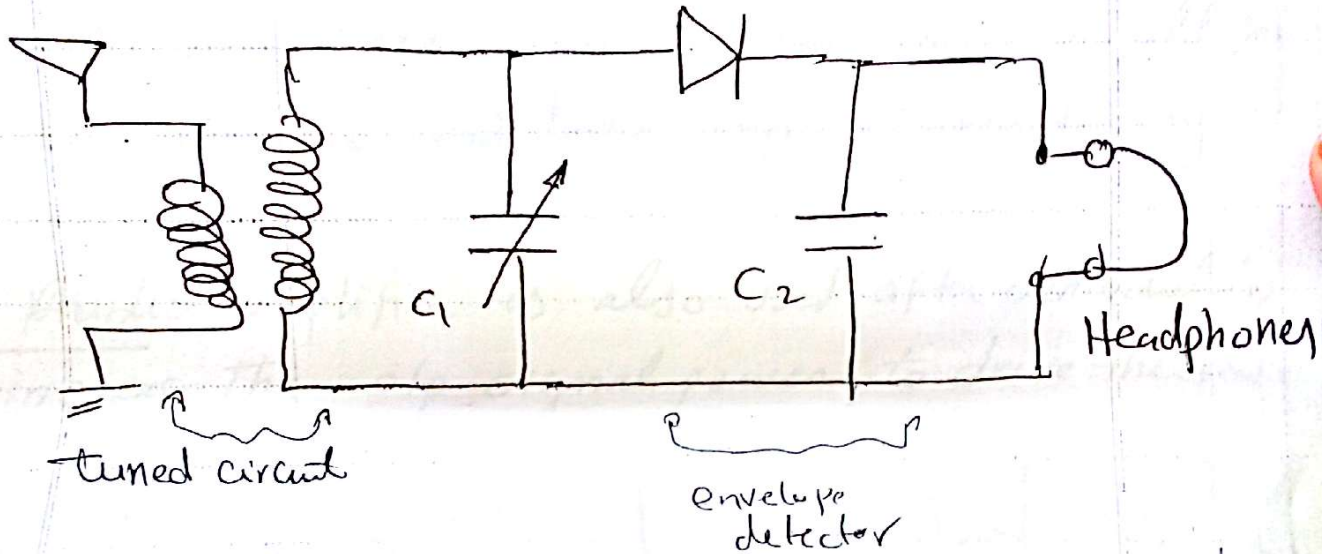
that the Rx can separate the desired signals from the unwanted signals

4

② envelope detector;

Consist of Diode (Crystal) and Capacitor
Serve as AM De Modulator

③ earphone, to reproduce the received audio signal.



② Tuned Radio Frequency (TRF) Receiver

وهو نظام إمدت النظام 1 لاسم حث في النظام لاسم
يخاف من بعض الصيغ و...

① low sensitivity $\Rightarrow$ No Amplifier

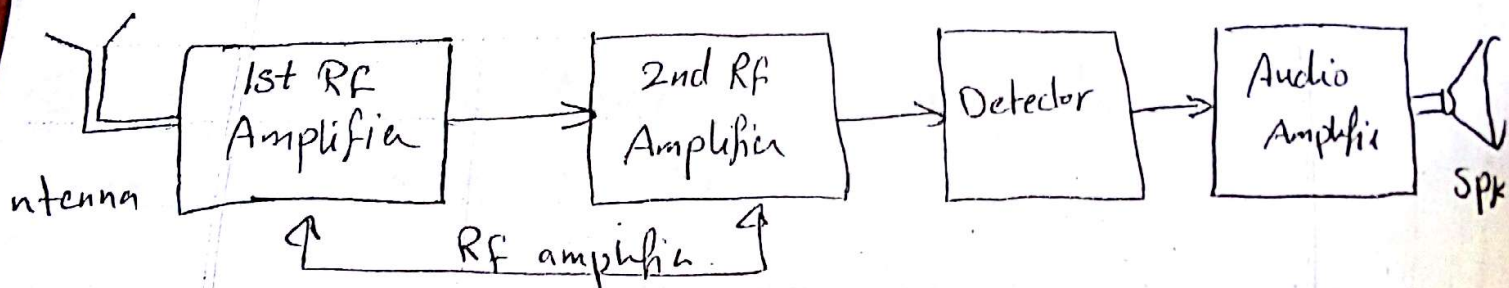
② poor selectivity $\Rightarrow$ only one tuned circuit
وكل تلك التي تعمل (TRF) Rx حث في حث
التردد لاسم كالتالي

TRF Rx

a) Sensitivity improvement by using groups of RF amplifiers between the antenna and the detector.

* The RF amplifiers stage increase the over all gain of the receiver and hence, improve sensitivity

* An Audio amplifier is also used after demodulator to increase the o/p signal power to drive the speaker

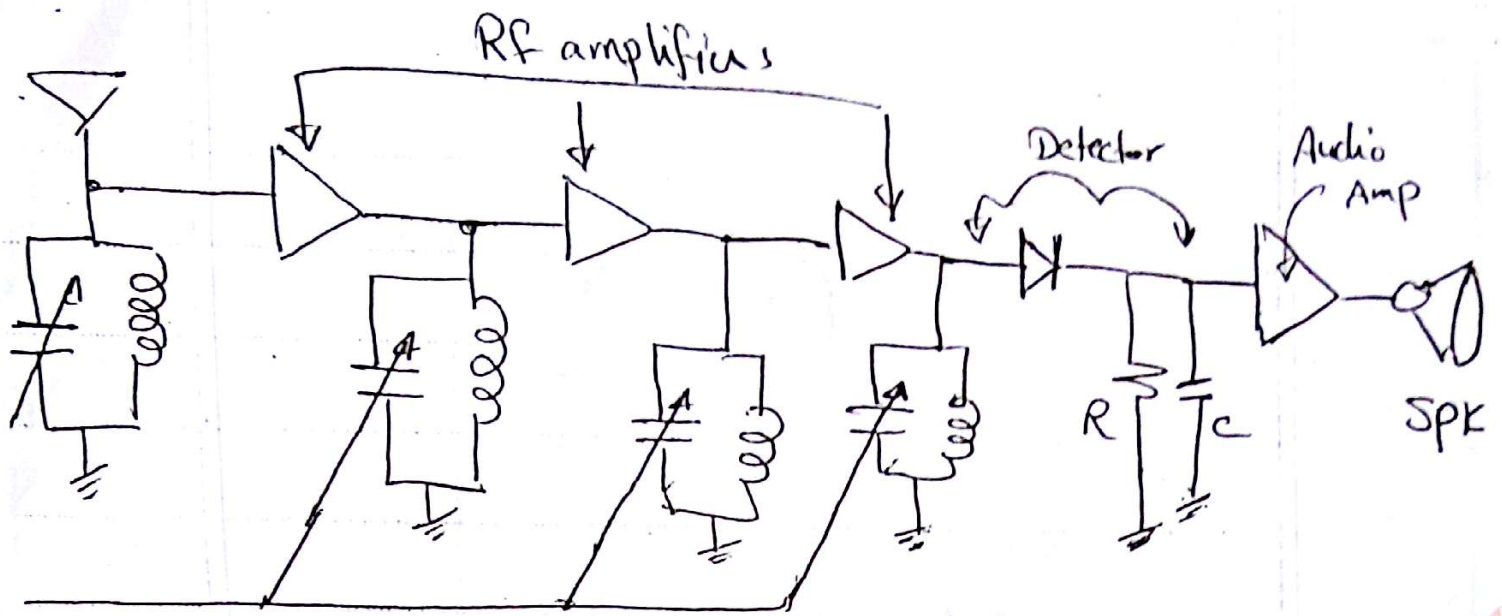


b) Selectivity improvement

⇒ By using multiple tuned circuit with RF amplifiers.

* the greater the tuned circuit the narrower the Bandwidth

* All the tuned circuit are variable to select the desired signal as shown in the figure



Disadvantage of TRF Receiver

- ① the selectivity of the tuned circuits is vary with the frequency.
- ② using multiple tuned circuit may be affect the desired received signal.

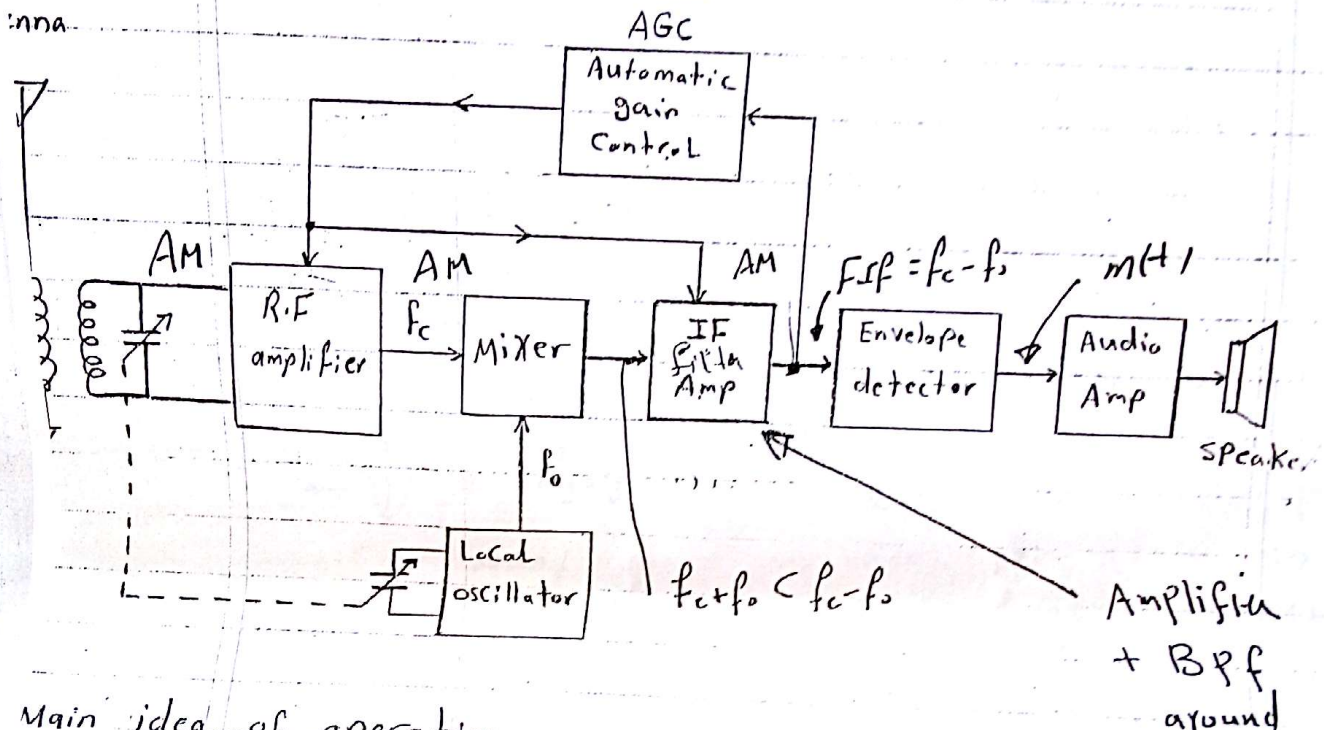


③ Super-heterodyne Receiver

هذا النظام من قلب على جميع المسائل

* hetro $\Rightarrow$ translation to another frequency.
 dynamis $\Rightarrow$ amplification of the detected signal
 Super $\Rightarrow$ from (super sonic) which means the heterodyn
 is above the audio freq. 7 range.

3) Superhetrodyne Receiver Block diagram



Main idea of operation:-

- The superhetrodyne receiver takes the incoming radio frequency signals whose frequencies varies from station to another and transform them into a fixed frequency called intermediate frequency (IF). $= f_{if}$

So that we get fixed receiver performance for all different signals.

يقوم بتحويل ترددات الإشارات المستقبلة ($f_{c1}, f_{c2}, \dots, f_{cn}$) إلى تردد واحد فقط ثابت يسمى (f_{if}) ثم يقوم بعمل demodulation وذلك نظراً لقلة عدد المحطات لكل المحطات أو الإشارات المستقبلة

Mixer

$$f_{c_i} \rightarrow \otimes \rightarrow f_o - f_{c_i} = f_{if} = 455 \text{ kHz for AM}$$

مختلج

التردد المذبذب

operation

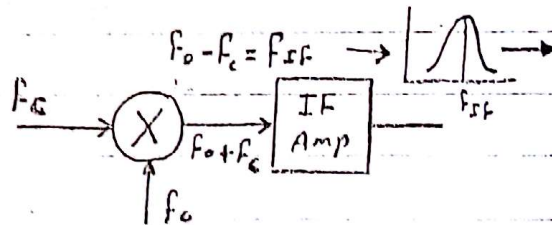
- 1] The antenna converts the received EM waves into electrical RF signals.
- 2] The tuned (LC) RF amplifier is properly tuned by varying the capacitor value to select the desired signal frequency (f_c).

• it also provides sufficient amplification for the radio signal by RF Amplifier

- 3] The local oscillator frequency (f_o) is tuned by varying the oscillator capacitor

the oscillator capacitor is coupled with the RF amplifier capacitor, and tuned together at the same time.

- 4] mixing →



The received signal frequency (f_c) is mixed with the tuned local oscillator frequency (f_o) to give a fixed frequency difference known as intermediate frequency f_{if}

$$f_o - f_c = f_{if}$$

عکس

For AM

$$f_{if} = 455 \text{ KHz}$$

(9)

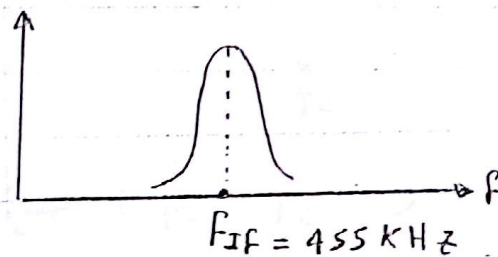
The mixer op will contain sum and difference freq,

$$f_o + f_c \text{ } f_o - f_c$$

(9)

[5] The IF amplifier is tuned to pass only the difference frequency ($f_o - f_c$) that equals the $f_{IF} = 455 \text{ kHz}$.

and reject all other frequencies ($f_o + f_c$ & ~~$f_o - f_c$~~)



• The IF amplifier amplifies the signal and provides more selectivity. $\rightarrow$ ~~input~~ ~~output~~ ~~response~~

[6] The output of the IF amplifier is fed to the envelope detector to recover the original signal. «mtt»

[7] The recovered signal is then amplified by the audio amplifier to a level sufficient to drive the loudspeaker.

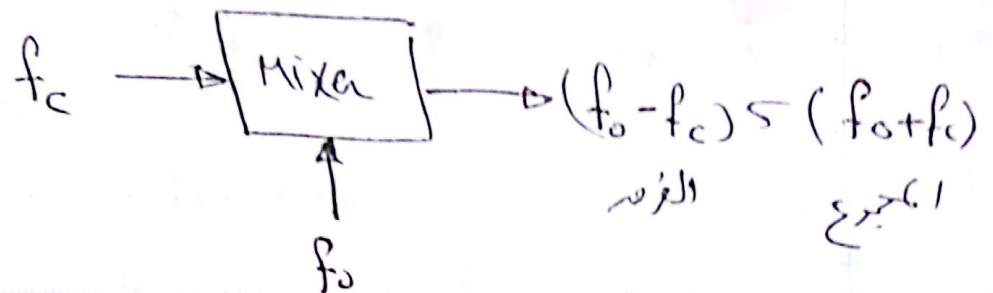
[8] AGC $\rightarrow$

* the near stations will have high power level while the far or distant stations will have lower power level.

To get fixed power level for all stations we use AGC circuit to adjust the gains of RF and IF amplifiers to provide a signal with fixed power level to the envelope detector.

Mixer operation

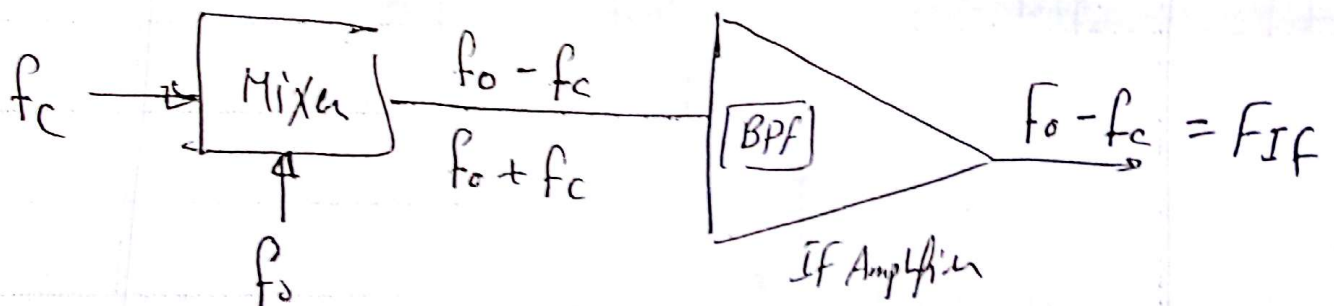
يقوم الـ Mixer بجمع تردد f_0 و تردد f_c لإنتاج



* لكي يخرج عبارة عن الفرق $(f_0 - f_c)$ حيث $f_0 > f_c$ وذلك عن طريق الجمع $f_0 + f_c$

IF Amplifier

يقوم الـ BPF بتمرير الفرق فقط



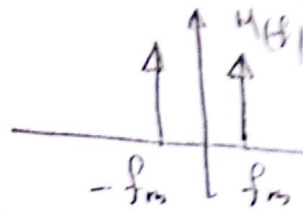
$$\therefore \boxed{\text{IF O/p} = f_0 - f_c = FIF}$$

$FIF = 455 \text{ KHz}$ for AM

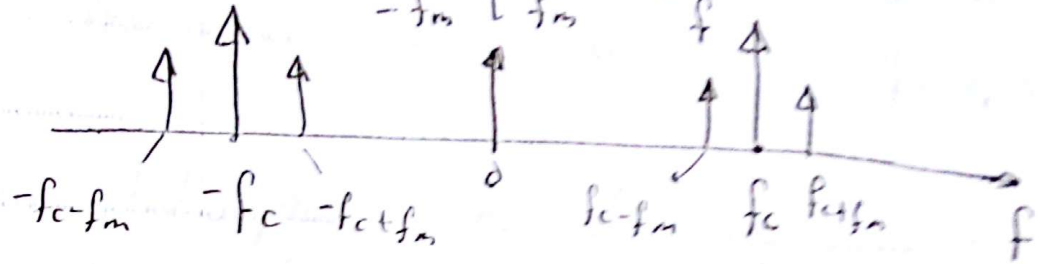
هذا ذكر خلاف ذلك

spectrum of all signals at Super heterodyne Rx

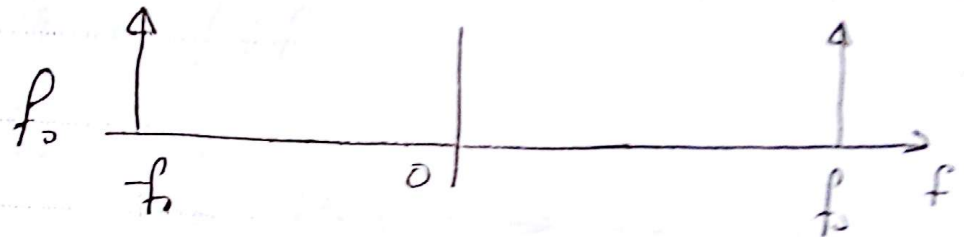
* $m(t) \rightarrow M(f)$



* AM signal

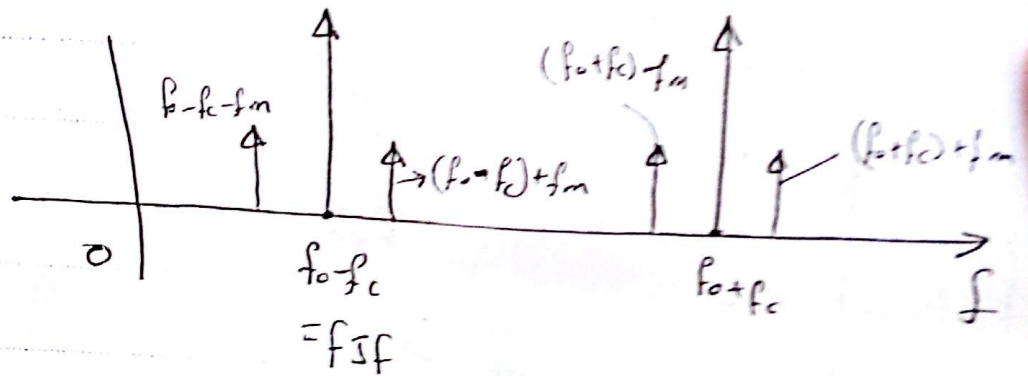


* Local oscillator f_o



* Mixer o/p

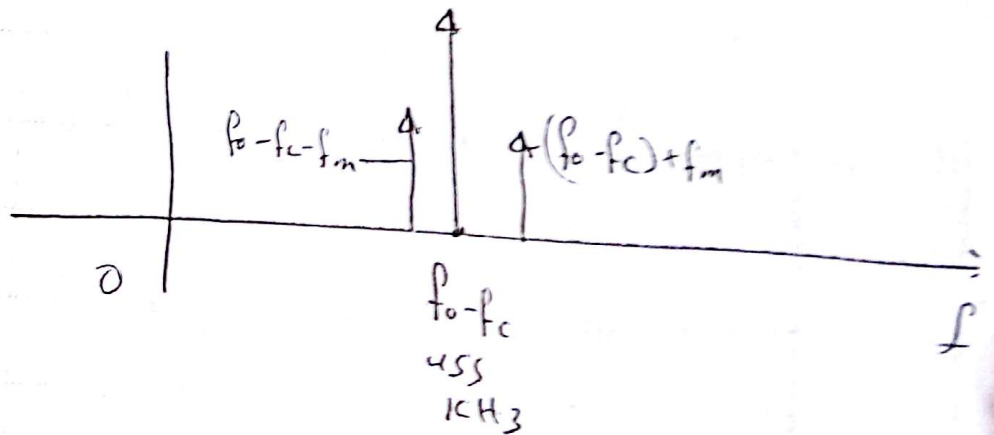
المزيج الناتج



* IF Amplifier

o/p

المزيج المعزز



* Detector o/p

$m(t)$

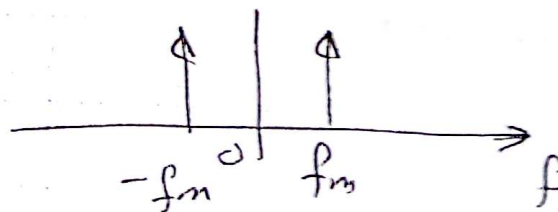
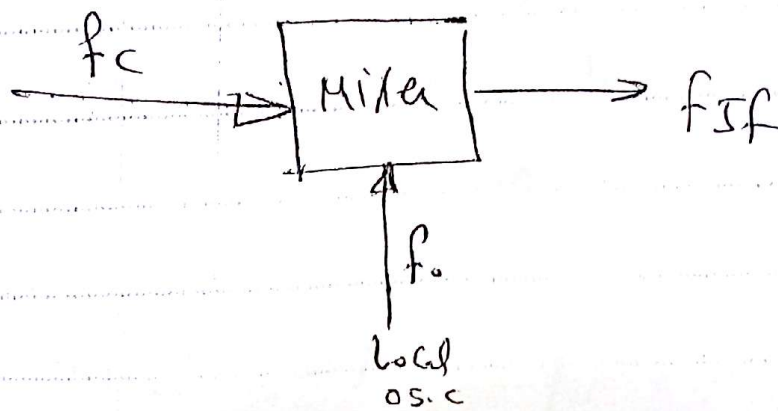


Image frequency

هناك أي إشارة غير مرغوب فيها تردد f_{imag} في Mix مع Local oscillator f_{LO} give f_{IF}

is any unwanted signal when its frequency mix with f_{LO} give f_{IF}



$$f_{\text{IF}} = f_o - f_c$$

$$f_o > f_c$$

$$f_o = f_c + f_{\text{IF}}$$

$$f_{\text{IF}} = f_o - f_c$$

$$f_{\text{imag}} = f_c + 2f_{\text{IF}}$$

$$\text{or } f_{\text{imag}} = f_o + f_{\text{IF}}$$

والتي في كل مرة
التي هي استلام
poor tuned circuit
|| من اشارة (Antenna)

$$f_0 > f_c$$

$$f_{IF} = f_o - f_c$$

$$f_{\text{imag}} = f_c + 2f_{\text{IF}}$$

$$= f_0 + f_{\text{IF}}$$

Down side Conversion

$$f_c > f_o$$

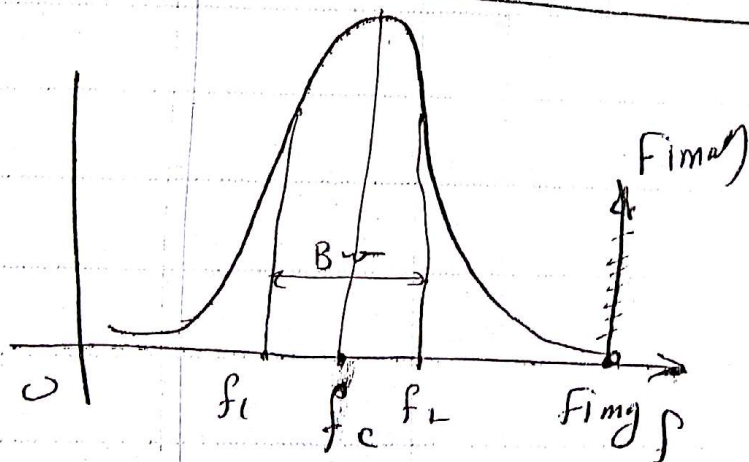
$$f_{rf} = f_c - f_o \rightarrow \text{الفرق}$$

$$f_{\text{imag}} = f_c - 2f_{IF} \\ = f_o - f_{IF}$$

نarrow band tuned circuit عمل image
 فc بیت این بکوه
 دلا میرا ال Image

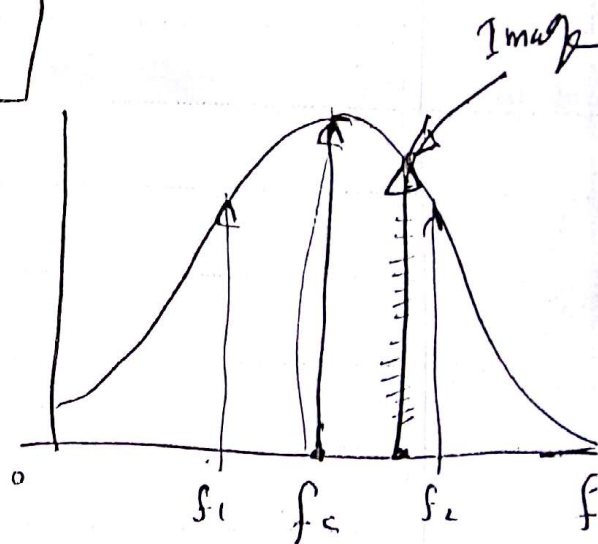
$$B_{\omega} = \Delta F_{RF} < 2f_{IF}$$

tuned circuit



$$BW = f_2 - f_1 \approx \Delta f_{RF} < 2f_{IF}$$

هنا ال Bio صفيرولم
ال Image انه عمر



$$B_w > 2fIf$$

no. 20 Fmge dkt
tuned circuit —